EYE DETECTION

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"This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Control and Instrumentation)"

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NOVEMBER, 2009

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ACKNOWLEDGEMENT

Alhamdulillah, His Willingness has made it possible for the author to complete the final year project in time.

I would like to take this opportunity to express gratitude to my dedicated supervisor, Mrs. Nor Farizan binti Zakaria for guiding this project at every stage with clarity and that priceless gift of getting things done by sharing her valuable ideas as well as share his knowledge. I would also like to thank to all UMP lecturers who had helped directly or indirectly in what so ever manner thus making this project a reality.

Not forgotten are my best colleagues for their openhandedly and kindly guided, assisted, supported and encouraged me to make this project successful. My heartfelt thanks to my dearest family which always support and pray on me throughout this project. Their blessing gave me the high-spirit and strength to face any problem occurred and to overcome them rightly.

The great cooperation, kindheartedness and readiness to share worth experiences that have been shown by them will be always appreciated and treasured by me. Besides that, I also wish acknowledgement to the people who give support direct or indirectly to the project and during the thesis writing. Once again, thank you very much.

ABSTRACT

Eye detection is a process where the position of the eyes is extracted from the face images. Eye detection is one of the applications in image processing. This project is important in human identification and it can improve today's identification technique that only involves the fingerprint to identify people. This eye detection is applicable in security system and drowsiness detection. This technology is still new and only few systems are applying this system as their security system. The most crucial part in eye detection system is to identify the eye location. This system is focus on four major parts of preprocessing phase which are image enhancement using median filtering, threshold process, feature extraction and the face and eye detection. This system used an offline face image database. The frontal face image is fed to the system which threshold the image to convert the image into binary image. This process produced an enhanced image after the filtering process. After these preprocessing, feature extraction process is performed to produces the features of the binary image. The face region is determined using rectangular function in MATLAB to limit the range of image to be process and to reduce the noise. Next, the eyes are detected using the morphology technique. A dilation technique is applied to build the square using the structuring element. The eye is view in a square region. Finally, the graphical user interfaces is designed to display the output image.

ABSTRAK

Pengesanan mata adalah satu proses di mana kedudukan mata dikeluarkan dari imej muka tersebut. Sistem pengesanan mata merupakan satu sistem yang menggunakan pemprosesan imej. Projek ini penting dalam pengenalan manusia yang boleh meningkatkan lagi sistem pengenalan manusia pada hari ini yang hanya melibatkan cap jari sebagai pengenalan manusia. Sustem pengesanan mata ini boleh digunakan dalam sistem keselamatan dan pengesanan mengantuk. Teknolgi ini masih baru dan beberapa sistem menggunakannya sebagai sistem keselamatan. Bahagian paling genting dalam sistem pengesanan mata adalah untuk mengesan kedudukan mata itu. Sistem ini menfokuskan empat bahagian besar dalam proses permulaan iaitu pemulihan imej dengan menggunakan teknik median, teknik ambangan dan pengesanan wajah dan mata. Projek ini menggunakan pangkalan data imej muka tertutup. Muka hadapan wajah ditukar kepada imej binari. Teknik ini menghasilkan imej yang telah dipulihkn selepas proses penyaringan dijalankan. Selepas proses permulaan, Process pengeluaran ciri dijalankan ke atas imej binari. Bahagian wajah dikenal pasti dengan menggunakan teknik segi empat tepat yang terdapat di dalam Matlab untuk menghadkan lingkungan imej untuk diproses serta mengurangkan halangan. Selepas itu, mata dikesan menggunakan teknik morfologi. Teknik pengembangan digunakan untuk membina satu segi empat sama dengan menggunakan unsur pembinaan. Mata dikesan berada di dalam segi empat sama tersebut. Akhir sekali, GUI direka bagi mempamerkan keputusan imej.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Human eyes detection has been a fundamental and challenging problem for computer vision area. It can be used to ease the problem of finding the locations of other facial features for recognition task and human-computer interaction purposes as well. [6] Eye detection is a process where the position of the eyes is extracted from the face images. Eye detection is one of the applications in image processing.

In electrical engineering and computer science, image processing is any form of signal processing for which the input is an image, such as photographs or frames of video. The output of image processing can be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional (2D) signal and applying standard signal-processing techniques to it. [12]

This project is involved image processing method that includes threshold, filtering, feature extraction, segmentation and detection method. In order to detect the position of the eye, the face region must be initializing first. This process is called face detection. Face detection can be regarded as a specific case of object-class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. Face detection can be regarded as a more general case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces. [11]

Early face-detection algorithms focused on the detection of frontal human faces, whereas newer algorithms attempt to solve the more general and difficult problem of multi-view face detection. That is, the detection of faces that is either rotated along the axis from the face to the observer in-plane rotation, or rotated along the vertical or left-right axis or both. [11] This project is use MATLAB software and all the programming of the eye detection system is written in the M-file (editor). MATLAB is a high-performance language for technical computing. The name MATLAB stands for matrix laboratory. [18] All the process in build this eye detection system must followed the step of image processing process. Beside that, the programming will be test with many face images to make sure the system is suitable to be applied for all face images.

1.2 Problem Statement

Eye detection system is important in human identification that can improve today identification technique that only involves the fingerprint as the input to identify people. The aim of this project is to detect the eye from the face image. This involved image processing method that produced the enhanced image. Eye detection is the beginning of the iris recognition system that is very effectively to be applied in security system. Eye detection is applicable in security system and drowsiness detection. Security is the degree of protection against danger, lost and criminal.

Today security systems mostly use password security system as a protection system. A password is a series of characters or a short phrase used to protect access to a system or file. The password security has been applied for bank card and door lock accessing. The password usually contained six characters long. Every people will build a password for their bank card and usually a big company will create a password that will be used to enter the company. People must remember the entire password. A problem will occur when the people forget the password or the password has been stolen. The weaknesses of this system can big problem for example another person can access the bank card and the company without any permission.

So this project, eye detection is one of the solutions of this problem. This project can be proceeded to produce iris recognition that can be a new security system. This system is more safety and effective because everybody has a difference iris. The people do not have to remember anything, just put the eye near the iris detector and they can access the bank card, door or others application. This eye detection can improve today security system to be more safety.

Beside that this eye detection is also crucial in drowsiness detection. Automotive vehicles clearly bring great value to society, providing a cost-effective means of transporting goods and people all over the world. Unfortunately, there are a corresponding number of automotive accidents and fatalities which continue to increase worldwide, prompting the World Health Organization to project automotive related deaths as the number three cause of death by the year 2010, up from number nine in 2002. Together, the auto industry has been working with governments around the world, from both a regulatory and technology standpoint, to reduce the number of automotive related deaths. Through increased driver education and awareness of potential hazards, the automotive industry is striving to promote accident avoidance and prevention to increase overall automotive safety. [4]

The drowsiness detection application is highly computationally intensive and it warns when a driver is “nodding off” or falling asleep behind the wheel. [4] These mean that the eye detection is very important for drowsiness detection to avoid accident.

1.3 Objective

The objective of this project is to:

i. To detect the human eyes from the frontal face image.

ii. To enhance the face image.

iii. Design GUI system to display image.

1.4 Scope of Project

The scope of this project is limited to the preprocessing phases which include four major steps. The main focus of the scope is to develop the system of eye detection focusing on preprocessing phases. This project is developed using MATLAB version 7.1. The additional scopes of project to be considered are:

i. Only use offline database.

ii. Use frontal face image for eye detection.

iii. Eye detection using MATLAB.

iv. Use single face image at one time.

Figure 1.1 Example of Frontal Face Image

1.5 Thesis Organization

Thesis is divided into five chapter essential chapters ranging from Chapter 1 until Chapter 5. The Chapter 1 gives an overview of the research conducted. It also discusses the problem statement, objective and the scope of the project. The problem statement is about the problems that occur in today life and the advantages of applying this project. The objective is about the aim that I want to achieve for this project and the scope of the project is about the limitation that I used in this project.

Meanwhile, Chapter 2 is the review of the previous research works conducted by many researchers outside. All relevant researches taken from the technical paper, journal, and books are discussed in details.

Chapter 3 reveals the techniques and the algorithms that are used to perform in this project. It also discusses the process flow of the project in detail.

All the result of the process is detailed out in Chapter 4. The output image for each process is displayed in this chapter. There are also discussions based on the result.

Finally, the Chapter 5 concludes the entire thesis and there are also some recommendations to improve this project. In this chapter also stated that all the objective of this project has been achieved.

CHAPTER 2

LITERATURE REVIEW

2.1 An Overview of the project

Human recognition has been studied for more than twenty year. It also becomes ones of the most attractive and challenging areas in pattern recognition and computer vision because there are a lot of potential commercial applications [9]. There many research that has been done about face recognition that involves eyes detection. Several method and technique implemented for each research to get the actual eyes detection result.

This project is used MATLAB software. MATLAB is a high-performance language for technical computing. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include Math and computation Algorithm development Data acquisition Modeling, simulation, and prototyping Data analysis, exploration, and visualization Scientific and engineering graphics Application development, including graphical user interface building. [18]

MATLAB features a family of add-on application-specific solutions called toolboxes. The toolboxes allow us to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. There is also an image processing toolbox in MATLAB. [18]

The Image Processing Toolbox is a collection of functions that extend the capability of the MATLAB numeric computing environment. The toolbox supports a wide range of image processing operations, including Spatial image transformations Morphological operations Neighborhood and block operations Linear filtering and filter design Transforms Image analysis and enhancement image registration deblurring region of interest operations. [18]

Computer vision is the science and technology of machine that see. As a scientific discipline, computer vision is concern with the theory for building artificial systems that obtain information from images. The image data can take many forms, such as a video sequence, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technology discipline, computer vision seeks to apply the theories and models of computer vision to the construction of computer vision systems. [9]

The examples of the applications of computer vision systems include systems for controlling processes, detecting events, organizing information, modeling objects or environments and interaction that are a computer-human interaction. [9] Real Time Detection and Tracking of Human Eyes in Video Sequences from Zafer Savas used video sequence. “Eye tracking and eye movement based interaction using computer vision techniques have the potential to become an important component in future perceptual user interfaces. In general, the term “eye detection” is widely used when static face images are of concern and the main aim is to find the face region which contains both eyes, and eye tracking term is used referring to the process of continuously detecting eyes in video sequences which contains only face images”.[25]

“In this thesis the term eye tracking means real-time, continuously detection of human eyes individually. Eyes are the most important features of human face. So effective usage of eye movements as a communication technique in user-to-computer interfaces can find place in various application areas. Our cost effective, robust, fast and real-time tracking solution to this problem depends on simple computer vision techniques with easy to implement setup and has the property of tracking with scale and rotation invariance properties”.[24]

2.2 Face and Eye Detection

Face recognition is a field of biometrics together with fingerprint recognition, iris recognition, and speech recognition and so on. Automatic extraction of human head, face boundaries, and facial features is critical in the areas of face recognition, criminal identification, security, surveillance systems, human computer interfacing, and model-based video coding. In general, the computerized face recognition includes four

steps.[19] First, the face image is enhanced and segmented. Second, the face boundary and facial features are detected. Third, the extracted features are matched against the features in the database. Fourth, the classification into one or more persons is achieved.

In order to detect faces and find the facial features correctly, researchers have proposed a variety of methods which can be divided into two categories. One is based on gray-level template matching, and the other is based on computation of geometric relationship among facial features. Face detection is the most important part of face identification and it is difficult due to varying of illumination, pose of head, and face expression.[19]

Eye detection is also the most important and critical task of face detection [6, 7]. In the paper, they propose a new approach of eye detection using gray histograms in eye candidate regions. Their eye detection algorithm works on face region determined by the method presented in [17]. In this project the face region is determine first. The eye region is detected after that. This method has been used by other researcher in their project for example Antonio Haro Myron Flickne and Irfan Essa. They stated in their project paper that the faces are usually chosen to be located first because they occupy more of the image than their features. [10]

The structure image is defined as the binary image which contains the structure feature of human face. Then, a binary eye pair template is used to find eye pair candidates in the image. All the eye pair candidates are then rescaled to a fixed size and sent to an SVM classifier that verifies the candidates and obtains real eye pairs.[21] This articles give some information for eye detection methodology and also about the filtering process. Qiong Wang and Jingyu Yang used binary template matching, SVM and variance filter in their project. Beside that they also use a face database that is from BioID face database as their input image.[14]

2.3. Image Analysis

Image analysis is the extraction of meaningful information from images, mainly from digital images by means of digital image processing techniques. Image analysis tasks can be as simple as identifying a person from their face. [12] This project used the offline database that contains the frontal face image. With the development of computer vision, computer graphic and pattern recognition especial with the deep research of face detection and face animation, many research institutes have built kinds of face databases to make experiment about correlative research and test algorithms.

The existing face databases almost are 2D images or videos applied in research of face detection, face recognition, face tracing, face feature selection, face expression and illumination. Faces in those databases vary in race, age, sex, pose, expression and illumination. [14]

2.4 Image Acquisition

According to Gonzalez C.R and Richard E.W (2002), "There are many ways where image can be acquired. The decision to use any technique is solely based on an individual." Image acquisition is the first step to get the face image using acquisition device. There two type of image acquisitions that are offline and online process. Offline image acquisition is acquired image using digital cameras, scanner and others, while online image acquisition is acquired image using the webcam devices or the other devices that can capture image for the real time system.